

Efficient Calculation of Regional Synthetic Seismograms

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The general behavior of regional seismograms as a function of source type, depth, distance, and frequency is not generally available in many regions of the world where seismic and human activity has not previously provided an empirical base of earthquakes, nuclear explosions, industrial blasts, mine bumps, and rockbursts. Under these circumstances, it is expected that discrimination practice may rely in part on theoretical transportation of discriminants tested in other regions of the world. In order to perform such a theoretical transport of an empirical discriminant, we must have a theoretical understanding of the behavior of that regional discriminant for both regional crustal structures. This work is intended to serve two objectives; provide more accurate and efficient means to compute, store, and retrieve synthetic regional seismograms for reference layered Earth structures and examine limitations to using layered Earth structures to model principal features of regional seismograms in the presence of lateral heterogeneity.

The project will provide means to efficiently compute wavenumber integration regional Green 92s functions on networks of UNIX workstations for layered Earth structures and then evaluate the use of layered Earth structures in discrimination research and practice. A system of programs including a user interface, a numerical seismogram generation module, and a database storage and retrieval interface will be developed. The Parallel Virtual Machine (PVM) library will be used to distribute the numerical load over a network of UNIX workstations. Wavenumber integration is an ideal candidate for parallel computing. Initial tests suggest that nearly linear improvement in calculation efficiency can be accomplished networks of CPU 92s using PVM. Improvements to existing wavenumber integration algorithms will include frequency dependent intrinsic attenuation, $Q(f)$.

Using 3D finite differences and layered Earth Green 92s functions, near-source and regional scattering will be simulated and implications for regional discrimination will be investigated. The intend of this research is to test scattering hypotheses for generation of regional waveform complexity, coda, and scattering attenuation while suggesting simple models to predict statistics of regional seismograms. Calculations will be performed using Tres3D with recursive grid refinement (RGR). This multigrid method makes efficient use of computer memory and CPU-cycles to maximize bandwidth of the finite difference calculation by placing small zones where there are low-velocity zones in the model and larger zones in regions of high-velocity in the model. Additional information on the RGR multigrid method may be found on the World Wide Web at the URL:
<http://www.scubed.com/products/tres3d/Tres3D.intro.html>